Equipping the Joint Warfighter with Unmanned Ground System Capabilities

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RS JPO Mission / Vision

- Mission

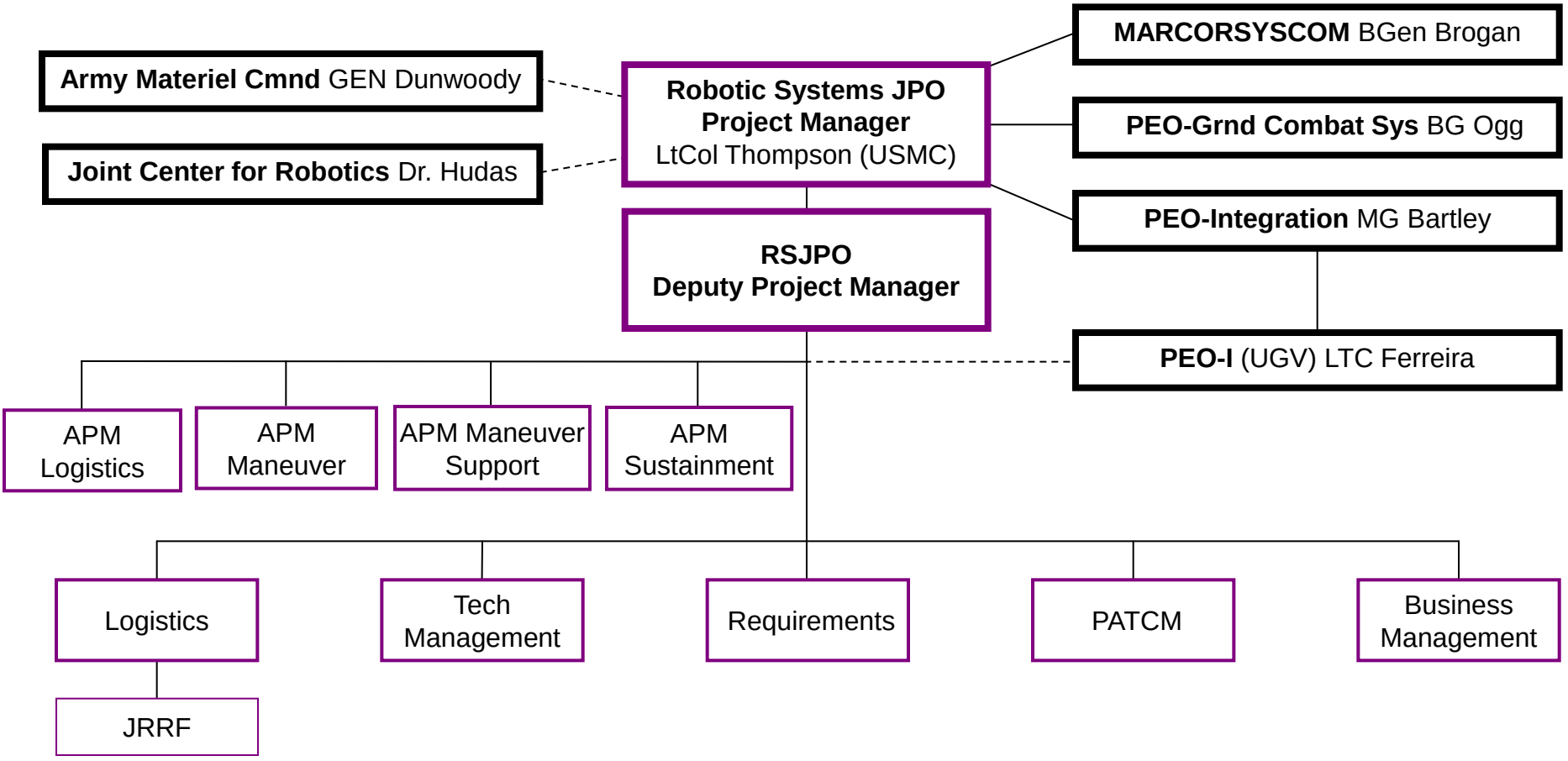
  Lead the development, systems engineering, integration, acquisition, testing, fielding, sustainment and improvement of unmanned systems for the Warfighter to ensure safe, effective and supportable capabilities are provided while meeting cost, schedule and performance.

- Vision

  Provide continuous improvement of unmanned system capabilities to meet current and future Warfighter objectives.

RSJPO Organization / Relationships

- **Army – USMC MOA**
- **Over 20 Robotic Systems**
- **Chartered by AAE**



RSJPO Joint Robotic Repair and Fielding Detachments in OIF/OEF

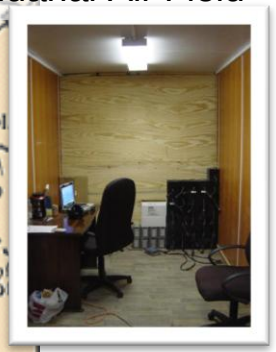
Iraq
-11 Soldiers/Marines
- 7 civilians
- 1400+ robots

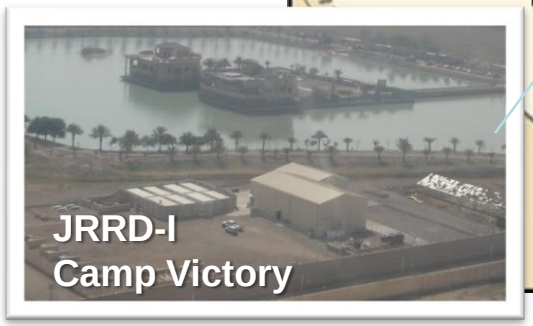
Afghanistan
-12 Soldiers/Marines
- 4 civilians
- 1200+ robots

Camp Speicher

Al Taqaddum Airbase

Kandahar Air Field



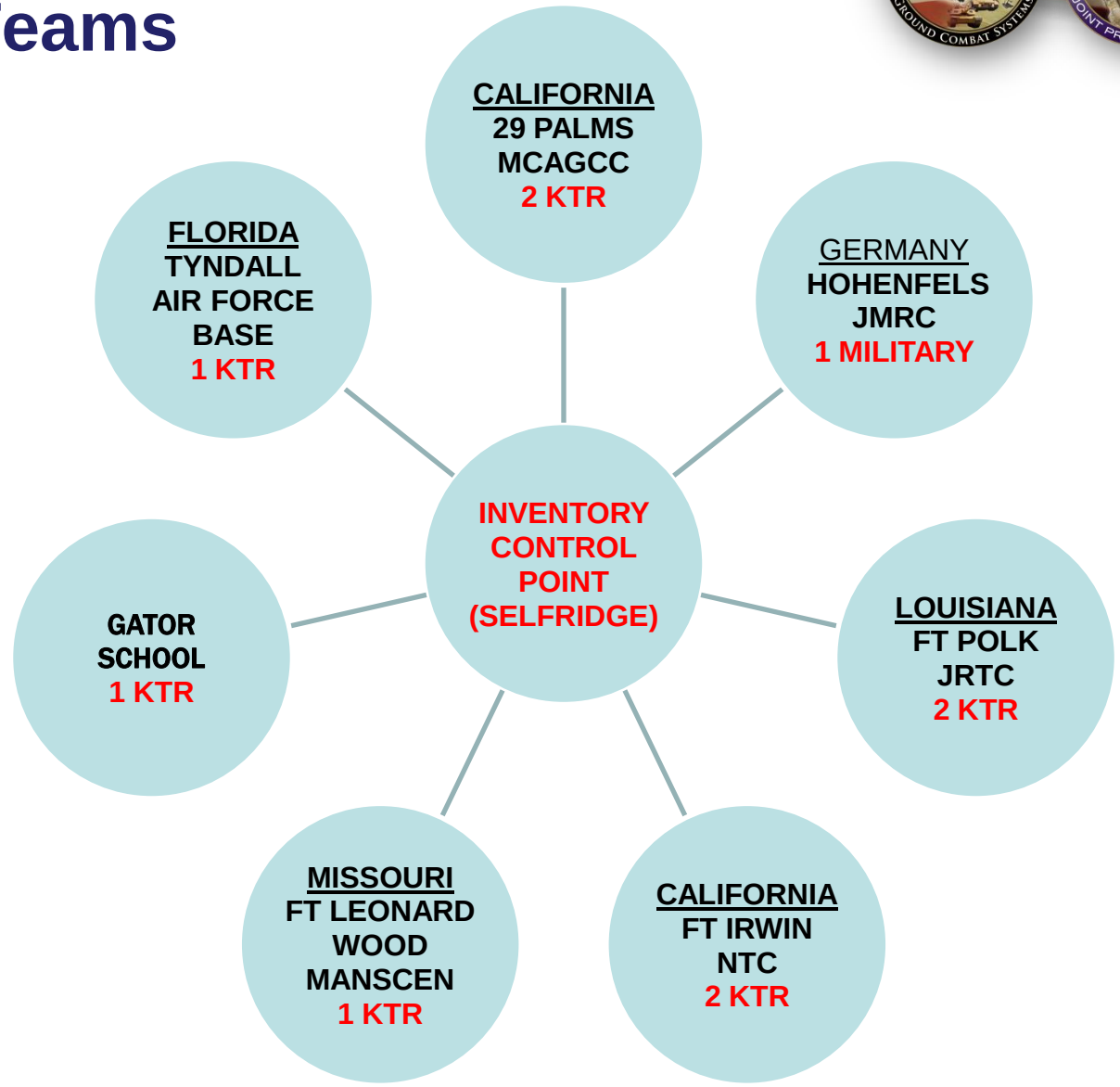


Camp Leatherneck

-Future sites at:
- -Sharana (RC-E)
- -Shindand (RC-W)
- -Mazar-E-Sharif (RC-N)

Credibility • Capability • Cost

Joint Robotic Repair Teams



Robotic Systems Portfolio

Maneuver

- IED Defeat Systems
- Disarm / Disrupt
- Reconnaissance
- Investigation
- Explosive Sniffer

Maneuver Support

- Area/Route Clearance
- Mine Neutralization
- Counter IED
- CBRNE

Sustainment

- Common Robotic Kit
- EOD
- Convoy
- Log/Resupply

Current Operations

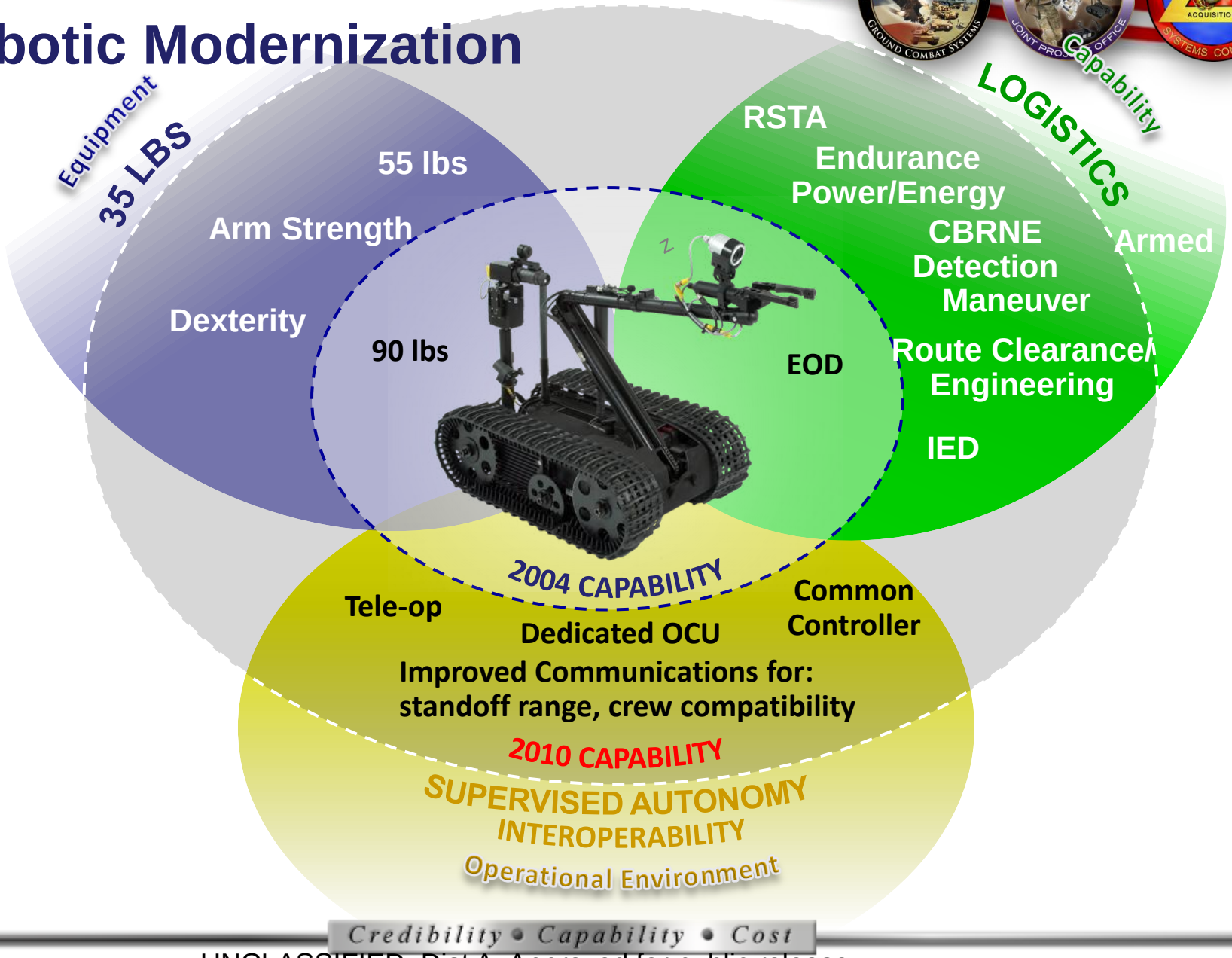
- ❖ Robotic systems have functioned properly and reliably during OIF/OEF
- ❖ RS JPO has fielded over 6000 ground robotic systems since 2004

What the Warfighter Wants:

- Better Communications
  - –Extended range and more robust
- Smaller, more compact devices
- Common controller
- Longer battery life/endurance
- Increased dexterity & agility
- More capable payloads
  - – Cameras, comms, sensors, etc.
- More systems

Although Warfighters are generally satisfied with current UMS, a common concern is the size, weight, and power (SWaP) and frequency allocation

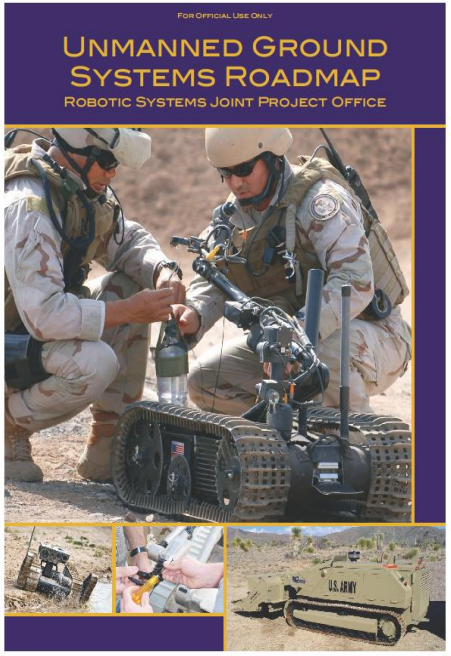
Robotic Modernization



RSJPO UGV Roadmap

- RSJPO Roadmap developed in coordination with variety of stakeholders and defines the perceived direction of Unmanned Ground Systems (UGSs) and technology
- Provides information to help guide the investments in UGSs based on the current and projected states of technology

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Communications	Technology	IP Addressable Radio		Software Defined Radio		Smart Antennae		Cognitive/Adaptive Radio Technology		Encryption Standards	Global Mesh Networking
	Capability	Single Radio Communications		Radio Diagnostics/ Status		Multiband/ Frequency Agile Radio		Increased Communication Range		Secure Communications	NLOS (across domains) / NLOS (satellite)
		← Higher Data Rates (throughout) →									
Navigation	Technology	Dynamic Real-Time Kinematics (DRTK - Localization)/ GPS			Inertial Navigation System (INS)		3D Recognition	Vision Based			
		← Sensor Fusion (throughout) →									
	Capability	Way Point Navigation	Situational Awareness		Way Point Navigation w/ Retro-Traverse	Semi-Autonomy	Formation Control/ Multi Robot		Operations in High Latency/ Low Bandwidth Environment		Autonomous Operations



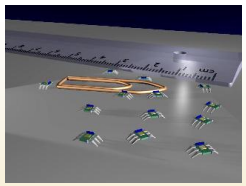
Family of Robotic Systems Payload Integration and Interoperability

Common payload interface across platforms by mission or class

Family of unmanned ground systems

MISSION EQUIPMENT PAYLOADS

Payload A | Payload B | Payload C | Payload D | Payload E






Payload Interface Standard Architecture

Emerging USA/USMC Requirements

NAME	Status	Purpose
Overarching Unmanned Systems	Draft ICD	Interoperable family of unmanned systems across domains
Squad Multipurpose Equipment Transfer	Draft CDD	Logistics/resupply vehicle
Family of Robotic Clearance and Interrogation Systems	Draft CPD	Prevent, detect and neutralize explosive hazards
Autonomous Mine Detection System	Draft CDD	Mine detection and marking
Explosive Detection Device	CPD to TRADOC	Handheld/Robot Mounted Explosive Detector
Squad Robotic Scout System	CDRT	Recon and surveillance
Manually Deployable Robot	Draft CPD	Recon and surveillance
III Corps Operational Need Statements	G3/5/7 validated but not resourced	Increased soldier safety and situational awareness thru intelligence and autonomy

SUPPORTING IMMEDIATE WARFIGHTER NEEDS WHILE ESTABLISHING PATH FORWARD FOR FUTURE REQUIREMENTS

III Corps ONS Overview

Autonomous Detection Vehicle

- Autonomous route investigation and hazard marking
- Fundamentally a robotic appliqué kit on a wheeled recovery vehicle to remove the Soldier from the vehicle for counter IED/route clearance.
- Funding exists for developmental phase (JIEDDO to NVL)

Convoy Logistics

- Kit-based, driver assist robotic follower system for current force tactical wheeled vehicles for increased situational awareness by the vehicle operator, giving increased opportunity for ambush and IED detection, and allowing for safer operation in limited visibility environments.
- Military User assessment at Fort Hood in the February 2010
- Funding exists for developmental phase and CONUS MUA

• Submitted by III Corps

Validated by G-3/5/7 13 Nov 09

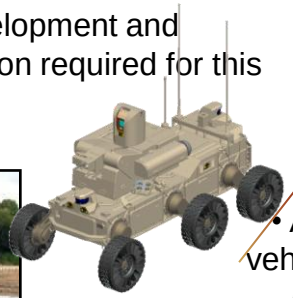
• Similar capabilities identified in JCIDS process, FCS ORD and other ONS/JUONS

•Fielding for OEF

• Varying levels of cost, schedule, performance risk and maturity

Robotic Wingman

- Large armed robotic platform assumes role as a member of squad / formation
- Leverage technologies under development by RDECOM under multiple ATO's
- Considerable development and technology maturation required for this capability

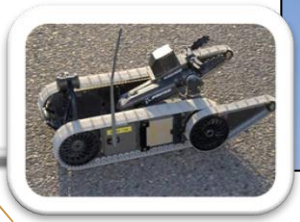


VOIED Defeat

- Capability for autonomous VOIED defeat
- Agnostic autonomous kit ready for any wheeled vehicle equipped with a suite of IED defeat payloads (rollers, cutters, rippers, blades, jammers, etc)

Persistent Stare

- A small robot with a sensor package that can navigate autonomously to a specified point and perform reconnaissance and surveillance enabling the robot to move through areas of anticipated enemy threat in order to provide real-time information to the operator within the carrier vehicle.



RS-JPO Spectrum Challenges

- Crowded spectrum
- Different requirements for different locations
- Changing legislation
- COTS acquisition approach
- Lack of designated bands for UGV operations
- Compatibility with jamming systems

ROBOTICS/UGV TRAINING IN CONUS

Designation Notice of Safety Band

FOR IMMEDIATE RELEASE
February 14, 2002

FCC DESIGNATES 4.9 GHz BAND FOR USE IN SUPPORT OF PUBLIC SAFETY AND PROPOSES LICENSING AND SERVICE RULES

Washington, D.C. - The Federal Communication Commission (FCC) has adopted a Second Report and Order and Further Notice of Proposed Rulemaking allocating 50 megahertz (MHz) of spectrum in the 4940-4990 MHz band (4.9 GHz band) for fixed and mobile wireless services and designating the band for use in support of public safety.

Situation

- Manufacturers produce Robotics in support of First Responders such as Police, Fire, and Emergency Medical Service (EMS) personnel using embedded safety band radios.
- Joint Urgent Operational Needs Statements (JUONS) issued, ordering that robotics be rapidly deployed to mitigate the Improvised Explosive Device (IED) / roadside bomb threats.
- Procurements of commercial off-the-shelf (COTS) robotics were rapidly deployed to OIF and OEF.
- Spectrum support continues to be provided in OEF and OIF. However, CONUS/OCONUS testing and training locations continue to be a challenge to provide FCC-allocated spectrum support or event-based coordination on a non-interfering basis.

Short-Term Solution in CONUS

• DD-1494s to certify WiFi band radio for replacement of the safety band radio have been submitted to ASMO.

• Contracts have been awarded to robotics manufacturers to verify functionality and distance / range of the robots with new radios, and to change CONUS robot configurations.

Current Actions

• 26 October 2009 Dept. of the Army, Ft. Benning, Memo for RSJPO: FCC Re-designation of the 4.94-4.99 GHz Frequency Band – RSJPO should modify the affected robotics systems NLT 1 January 2010 to enable continued use.

• AFMO is continuing support of 90-day Temporary Authorizations for the Safety Band radio while the RSJPO is continuing to transition training assets to the WiFi band.

UGV PERMANENT CONUS ASSIGNMENT STUDIES

DISA/JSC All-Purpose RemoteTransport System (ARTS) Frequency Band Study

• Recommends the Federal band from 4400 – 5000 MHz (4940 MHz is the understood limit).

• ASMO has also recommended the 4400 MHz Federal band for UGV operations, as it "…currently offers the most spectrum supportability.", as mentioned in the study.

•225 – 400 MHz was also recommended, but it is allocated in 25 kHz increments, and is unsuitable for SUGV video data links.

DISA/JSC Unmanned Systems Frequency Use and Availability Assessment

- Recommends 2.4 – 2.4835 GHz unlicensed band, and 5.6 GHz as an alternate.
- Assesses Mobile Service allocations as follows:
  - 230 – 235 MHz – co-primary with Fixed-limited to Military
  - 406.1 – 410 MHz – co-primary with fixed/radio astronomy
  - 410 – 420 MHz – co-primary with fixed/space research
  - 902 – 928 MHz – govt. mobile: low power/secondary basis
  - 1710- 1855 MHz – co-primary with fixed/space ops. (Note the relocation of 1710 – 1755 MHz, hence not available)
  - 2.2005 – 2.2905 GHz – mobile OPS restricted to LOS
  - 2.36 – 2.39 GHz – co-primary with radiolocation
  - 2.4 – 2.4835 GHz – co-primary with fixed and radiolocation
  - 3.3 – 3.5 GHz – NO ALLOCATION FOR MOBILE
  - 4.4 – 4.94 GHz – Co-primary basis with Fixed

Long -Term Solution Options to CONUS Locations

• Determine spectrum allocations specific to UGVs.
• Integrate spectrum agile (multi-band) radios

Issues/Guidance:

Radio options for existing platforms are limited by:

(1) the physical mounting designed for an embedded radio

(2) software compatibility allowing only one particular manufacturer of the radio chipset

(3) one type of connector interface

ROBOTICS/UGV TRAINING IN OCONUS

Situation

- Unable to operate training assets due to spectrum requirements in Germany (Hohenfels)
  - 18 MarcBots – non-operational
  - 5 PackBot FasTacs – non-operational
  - Talons – fiberoptic cable used for video
- 4.94-4.99GHz band – Land Military Systems (mobile applications not allowed)
- 2.4Ghz band – 100mW power limit – severely limits distance/range

Challenges

- 100mW limitation
  - Robots demonstrating only 20m LOS operation vs. 300m requirement
- Inability to maintain single configuration for both training assets and operational assets
- Inability to support ARFORGEN cycle for systems

Path Forward

- Continue converting from 4.9GHz to 2.4GHz
- Conduct market research for radios that meet system requirements while meeting German requirements

Actions Taken to Date

- Conversion of radios from 4.9GHz to 2.4 GHz
- Reviewed radios certified for use in Germany
  - Unable to integrate into UGVs due to hardware & software incompatibility
- Obtained temporary authorizations

CREW COMPATIBILITY OF UGV OPERATIONS

CREW Compatibility Status

• Understanding of up-to-date information for CREW compatibility with UGVs is ambiguous at best, because of the sensitivity of the information.

• During Safety and Performance Testing at the US Army Developmental Test Command (DTC), understood from the Unmanned Ground Vehicles Test Manager that CREW loads are taken into consideration during EMI and E3 testing. However, loads change periodically, and compatibility of future loads cannot be foreseen.

• Direction from CREW guided the SUGV community to most of the frequencies being used at this time.

•There is preliminary direction from CREW, stating that the SUGV community may need to vacate some of the frequencies currently being used in CENTCOM OIF/OEF.

Challenges

• The timeframe from DD-1494 submittal to issuance of a JF12 number can be the same amount of time as periodicity between CREW loadings. This means that by the time the JF12 number is issued, CREW may change the frequency loadings again, such that the DD-1494 is no longer applicable. This can be mitigated for CONUS by having robots designated as Training Assets for CONUS-Only operations.

• There are propagation issues associated with frequencies above 3 GHz. LOS operations are less forgiving when the radio link is interfered by a physical object in its path, or when the Fresnel zone is affected by differences in height between the robot and the hand-held controller.

Path Forward

• Outcome of meeting held in Jan 2010 with DTC, CREW, and some of the SUGV community, is that CREW is to form a new Working Group to meet on a periodic basis to stay informed and discuss CREW compatibility.

• Consideration is being given to submit to ASMO a Conceptual, Stage 1 DD-1494 requesting that an allocation be determined for SUGV operations.

Actions Taken to Date

• Communication established with CREW community
• Coordinating with NAVEODTECHDIV on common solution for UGVs

Questions